Patent Application of Th odore E. Anvick
for
Anvick Aperture Device and Method of forming and using same

Cross References to Related Applications

Not Applicable

Background -- Field of Invention

This invention relates to the design of framework for the reinforcement of structures, including reinforcement for cementations. more particularly. the invention relates to an ***aperture*** reinforcement device that girds and cinctures other reinforcement in order to enhance composite and ductile properties of reinforcement arrays.

Background – Description of Prior Art

U.S. patent 6,226,942 to Bonin; Pete J. (05/08/2001)

U.S. patent 6418686 to Record, (07/16/2002)

U.S. patent 3879908 to Weisman, Victor P. (04/29/1975)

U.S. patent 4,226,067 to Artzer, Richard, F. (10/07/1980)

U.S. patent 4,576,372 to Grutsch; George A. (05/14/1985)

U.S. patent 4,530,191 to Boisbluche; Arsene G. (07/23/1985)

U S patent 4,624,089 to Dunk r; Friedrich W. (11/25/1986)

U.S. patent 4,660,341 to Holtz; Neal (04/28/1987)

U.S. patent 4,702,053 to Hibbard; Donald B. (10/27/1987)

U.S. patent 4,715,155 to Holtz; Neal (12/29/1987)

U.S. patent 4,998,393 to Bacna; Juan A. M. (03/12/1991)

U.S. patent 5,058,345 to Martinez; Manuel J. (10/22/1991)

U.S. patent 5,398,470 to Ritter; et al. (03/21/1995)

U.S. patent 5,440,845 to Tadros; et al. (08/15/1995)

U.S. patent 5,487,248 to Artzer; Richard F. (01/30/1996)

U.S. patent 6,088,985 to Clark; Timothy L. (07/18/2000)

U.S. patent 6,237,297 to Paroloy; Richard (05/29/2001)

U.S. patent 6,272,805 to Ritter; et al. (08/14/2001)

Until now current and previous truss and panel designs have provided valid construction alternatives to more traditional configurations of building material. However, they have been unfamiliar to and have not been embraced by a construction industry well versed in prevalent wood, concrete masonry and steel building methods. Adoption of more stringent mandatory building code requirements with respect to seismic, wind, fire and energy conservation has progressed over the years, land and labor costs have risen, and the cost of raw materials has increased. This has caused the costs of the d velopment of wood,

steel frame, masonry block and poured in place concrete structures to rise significantly. Ri ing maintenance, and energy costs for finished structures have also increased the costs of operation and own rship. The benefits of truss and panel designs address all of these factors, and as a result, their price competitiveness has become apparent, reducing the resistance of the construction and fabrication industries to their use as mass production construction techniques. Both the construction industry and consumers will benefit from the development of faster, stronger, more durable and energy efficient construction techniques and structures employing them. Trusses and ***composite trusses*** of various kinds have been constructed *over* the years with a variety of designs, connections, methodology and materials. Some have been designed into space frames as the reinforcement matrix for structural panels with facings of cementatious material. In all such panels, the optimization of structural strength, ductility and consequent composite behavior is clearly desirable. Some have featured a disposition of elements attached so as to form loops or ***apertures*** of reinforcement. Such *apertures* have served to elaborate the embedment of reinforcement in cementations in an attempt to enhance composite action. However, such panels have been deficient in their ductility, that is, the ability to undergo changes of form without breaking or falling apart.

Building panels of various kinds have been developed over the years incorporating a variety of external facings, reinforcement, and internal insulating materials. Prefabricated panels are factory made and shipped to a site for assembly into interior and exterior walls of a building. Some panels are also made directly at the building site. Such prior panels typically have a framework, commonly of wood or metal studs and or wire, readymade with an insulative core and sometimes incorporating electrical wirings and plumbing. Prefabricated panels have means for attachment to each other along abutting edges and for attachment to roof trusses, rafters, flooring and foundations. Panels have been constructed to withstand the various types of forces that buildings typically undergo such as compression forces from floor loads and roofs. Such panels

have also been designed to provide insulation, weath r-tight sealing, and to be conn cted to adjacent panels, roof systems, and to footers. The panels have typically been connected to roof trusses or rafters using conventional brack ts, which are nailed to the wooden rafters or trusses and to wooden headers.

The brackets are designed to withstand the forces exerted by seismic events and the lifting forces exerted upon roof structures by wind. The structural systems of a building resist such forces well to the degree that they enable the building to behave as a unit under stress rather than failing at points of attachment or across surfaces, weakening the structure and making it susceptible to catastrophic failure. The degree of composite, or unitized, behavior of a structure and of the elements used to build it increases with increased ductility of structural interconnection.

The present invention is directed towards a means to construct monolithic composite insulated structures from elements that can comprise a panel system and that addresses composite behavior and ductility of structures. Said structure not only provides superior strength against compression and tension forces longitudinally, and laterally, and transversely but also anchors, braces, positions and strengthens structural trusses in a truss system. Walls, roofs, floors, and foundations are tied together in such a manner as to provide a greatly increased tension and compression and shear strength and resistance to lifting and shaking forces.

Brief Description of the Drawings

Fig. 1A is a Curvilinear web element.

Fig. 1B shows a truss with apertures formed between web vertices and dual attached cords.

Fig. 1C shows a truss with apertures formed between angled vertices and attached cords.

Fig. 1D shows one pair of intersecting trusses 12b in an array to form a pan l

assemblage.

Fig. 1E shows a longitudinal cross section of a plurality of trusses 12b Fig 1C in an array to form a panel assemblage Fig 1D.

Fig. 1Fand G show ductile right angle truss aperture interconnections (e.g. wall and floor).

Fig. 2A shows truss aperture formation by weaving of the web element over the cord.

Fig. 2B shows lateral reinforcement cinctured by apertures formed by alternating wed vertices.

Fig. 2C is a lateral cross section of a wrapped web cincturing both cord and lateral reinforcement.

Fig. 2D is a longitudinal cross section of a woven web aperture cincturing cords and a lateral.

Fig. 3A is a view of an independent locatable cincturing device.

Fig. 3B is a view s of an independently locatable cincturing aperture device.

Fig. 3C shows reinforcement cinctured at a right angel by the aperture shown in figures 3A and 3B.

Fig. 3D shows cincturing of a point loaded dual web, lateral reinforcement, a cincture-tightening bar and a longitudinal cord.

Fig. 3E, 3F show differing views of an alternate independent aperture device.

Fig. 3G, 3H show cro9ssing and lapping cinctured by an independent aperture device.

Fig. 3I,J,K show the form and use of another independent aperture.

Fig. 3L shows a locatable aperture laterally restraining reinforcement at a cord and vertex cincture.

Fig. 3M shows Mesh reinforcement cinctured between cords and lateral via truss aperture.

Fig. 4A shows an insulative panel core element grooved to position and dispose truss webs.

Fig. 4B shows a truss with curvilinear web integrated into grooves of an insulative

core element.

Fig. 5A shows a foundation conection, truss, cor , and cementation design alternative.

Fig. 5B, 5C show composite formats wit alternative aperture and positioning devices.

Fig. 5D is a truss core array with intersecting truss planes and aperture connections.

Fig. 5E is a truss and core with parallel truss planes and aperture connections.

Reference Numerals

6a-h Web vertices, vertices of independently locatable elements

7a-z web

8a,b cord of truss or lateral reinforcement

8c,d lateral cross reinforcement element

11 ***aperture***

12a, b truss

13a-z Independently locatable cincturing aperture device

13a locatable CU clip element

13c locatable W clip element

13 f restrained sheeting element

13g, h Alternate transverse lattice and locatable aperture

14 Positioning Groove

15 insulative core element

16 core transverse face

17 Sheeting elem nt

18 aperture footing reinforcement member

19 aperture truss footing reinforcement and longitudinal member spacing lement

20 Cementations

21a,b core restraining element

Preferred Embodiment – Description

A preferred embodiment of the ***aperture*** **11** of the present invention is comprised of a continuous reinforcement element **7** shown in **(Fig 1A)** bent to a curvilinear waveform forming vertices **6** and comprising a web **7** of a truss **12 (Fig 1B)** formed by affixing one or more chords **8a, 8b** to said web **7** at a predetermined location such that each vertex **6** extends beyond the attachment location of cords **8a, 8b** forming an ***aperture*** of predetermined size. An array of reinforcement comprised of a plurality of trusses **12 (Fig 2)** are integrated into a space frame shown in **(Fig 1)** of predetermined length, width, and thickness by the insertion and attachment of lateral reinforcement **8c,d** of predetermined size through aligned ***apertures*** **11** of spaced trusses.

truss **12** is disposed in spatial relationships with its neighbor by elements of an insulative core shown in **(Fig 4A)**, whose grooved transverse faces **16** fit the central web area of trusses **11**. Space frame **(Fig 1D)** is built up from interspersed truss **12** and insulative core elements **15**. The predetermined dimensions of core elements **15** dispose and establish truss **12** spacing and truss **12** in turn positions core elements **15** in relation to space frame **(Fig 1E)** reinforcement attachments to allow required embedment in the event cementations **(20)** are applied.

In another preferred embodiment ***aperture*** **11 (Fig 1c)** is formed in truss **12b** by attachment of cords **8a,b** to web 7. {Cords **8a, b** are distinguished by being located on laterally opposite sides of web **6** without regard to their transverse relativ position.}Vertices **6** of web **7 (Fig 1C)** are bent at equal but opposite angles on transversely opposite sides of web **7 (Fig 1C)**. As shown in A space

frame **(Fig 1D)** comprises a plurality of trusses **12b** with each truss **12b** rotated 180 degrees from its neighbors around a transverse axis. Th n each truss **12** in a given plurality is spaced, positioned and rotated equally and in opposite directions from its neighbors around a longitudinal axis so that the angled vertices **6** **(Fig 1D)** of neighboring trusses **12b** lie flush with each other, sandwiched between two cords **8a,b**. (Planes folded plate) Paired ***apertures*** **11** **(Fig 1D)** are then integrated laterally by the insertion of lateral reinforcement 8c,d through and attachment to aligned apertures **11** comprised of the bounding vertices **7** and cords **12** of the space frame array **(Fig 1D).**

frame **(Fig 1D)** is shown in lateral cross section in **(Fig 1E)** presenting a folded plate truss structure comprised of lateral reinforcement cords **8c** interconnecting and cinctured by apertures **11** formed by vertices **6a** and longitudinal truss cords **8a**. Truss web elements **7** serve in both longitudinal and lateral truss structures intersecting, in space frame **(Fig 1D),** to form substantially quadrilateral-based pyramidal structures. Each pair of vertices **6a** and cincturing apertures **11** form the apex, or summit vertex, of a pyramidal structure and also one corner of the square base of a neighboring inverted pyramidal form A transverse cross section shown in **(Fig 1E)** reveals the resulting a folded plate truss structure and space-frame **(Fig 1D)** thus provides three dimensional structural action. In this preferred embodiment appropriately shaped and grooved core elements may also used to dispose, position, and assemble space frames (Fig 1D) from trusses **12b** and lateral reinforcement **8c, 8d** forming modular panelized insulative core and reinforcement components for embedment in cementations.

Perpendicular ductile truss connections **13** in which ***apertures*** **11** (Figs 1G and 1H) formed by two connected web elements of a truss are overlapped in the area of truss interinterconnection such that lateral reinforcement **8c, 8d** passes through ***apertures*** of both trusses at interconnection points **13a** and **13B**.

Apertures **11** Fig 2A are formed by the weaving and attachment of web **7b, 7a**

elements around dual cords **8b, 8a** to form vertices **6b, 6c** each of which wraps one cord **8a, 8b** to form cincturing vertex **11**.

truss **12 (Fig 2B)** is configured with v rtices **6d, 6e** alternating from side to side of a single cord **8** forming cincturing ***apertures*** **11** girdling lateral reinforcement **8c, d**.

Apertures **11** are formed by the bending, weaving, sewing, or tying of web **7**. **(Figs 2D and 2E)** is a longitudinal cross section view of two truss cords **8a, 8b** and perpendicular lateral reinforcement **8c, d** girdles and cinctured by ***aperture*** **11** formed by continuous web **7**.

lateral cross section view of another ***aperture*** **11** formation on a similar principle of bending, weaving, sewing, or tying of web **7** to girdle and cincture lateral and longitudinal cords **8** and transverse reinforcement **8c, d**. Three vertices **6i, j, k** and three ***apertures*** **11** formed (Fig 2E).

Apertures **11** formed by independently locatable cincturing aperture reinforcement elements **13** (cincture **13**) of predetermined dimensions(Figs 3A and 3B).

application of locatable cincture **13b** cincturing two reinforcement elements. Cincture **13b** saddles one reinforcement element **8**, and the second is then communicated through the girding apertures formed between the saddled reinforcement **8** and the vertices **6g** or **6h** of cincture **13a** left unoccupied by the saddling procedure **(Figs 3C)**.

An application of locatable cincture **13b** to web **7**, cord **8**, and lateral reinforcement **8c, d, 8e (Fig 3D)**.

views of locatable cincture **13c** applicable as described for cincture **13b** by saddling and insertion of reinforcement **(Fig 3E and 3F)**.

cincture **13d** used for both crossing and lapping reinforcement**(Figs 3G and 3H)**.

of locatable cincturing devices**(Figs 3I through 3L)**.

Preferred Embodiment – Operation

The manner of using the ***aperture*** device **11** is adaptable to structural requirements of any given form or disposition and can be erected as follows:

pan ls can be fabricated and crectcd as framework reinforcement at site as follows:

a pref rred embodiment an element of said core **15** panels are placed on a horizontal surface with an edge **16** facing upward which has been grooved **14** to fit and position a truss **12**. In this example, two opposite edges **16** of core panel **15** element are grooved **14**. An adhesive is applied to said edge **16** and an element of an ***Anvick aperture* (11) *composite truss*** **12a-z** configuration is fitted within the preformed grooves **14** which accept half of the girth of the webbing element **7** and position said element with respect to said core panel**15**. A corresponding grooved core panel**15** element is fitted on top of the first element and completes the embedment of the first truss **12** configuration. The positioning is such that there is sufficient clearance between the truss **12** and reinforcement attachment points **8a,b,c,d** for required embedment in cementations **20**. This process is repeated, the core panel elements **15** aligned flush with each other and positioning the truss **12** array, until the desired panel width is assembled. Once said adhesive has set the panel can be set in place on an arrangement of reinforcement protruding at predetermined spatial relation from a previously formed foundation structure **18**. Independently locatable ***aperture*** cincturing devices **13a-z** attach the foundation reinforcement **18** to either the lateral **8c,d** or longitudinal **8a,b** reinforcement elements when the ***aperture*** connecting, lateral reinforcement **8c,d** are inserted through the ***apertures*** **11**. Welded wire fabric **19** can be installed, if called for, prior to the addition of said lateral reinforcement **8c,d**, which then serves to cincture **13f**, said fabric when installed over it. System components alternatively may be fabricated off site.

In another preferred embodiment each truss **12b** in a given plurality is spaced, aligned, and then rotated in an opposite direction from adjacent trusses **12b** so that they intersect at their corresponding ***apertures*** **11.** Said ***apertures*** **11** of said adjacent trusses **12** are bent at an angle to the web **7** so that they lie flush with one another. Cords **8a and 8b** of said trusses **12** sandwich the attached, paired, flush positioned vertices **6a** forming paired ***apertures*** **11**. Reinforcement **8c,d** is then inserted and communicated through and girded within said ***apertures*** **11** to complete an embodiments basic array. The resulting array is a folded plate structure with multidirectional truss **12** behavior. Said curvilinear and or wave form webbing **7** effect provides for a real three dimensional structural

action once connecting reinforcem nt **8,c,d ,and 18**, and cementations **20** are installed.

In this preferred embodiment a truss **12b** structure is elaborated by assembling said trusses **12** edge to edge in planes which intersect at longitudinal lines of vertices **6a** which alternate from side to side of the resulting three dimensional space frame, along a transverse axis perpendicular to a longitudinal axis. This transverse axis in cross section consequently resembles a longitudinal cross section, consisting of alternating substantially equilateral triangles, neighboring triangles inverted, between parallel lines, bases of said triangular cross section composed of cords **8c,d** which pass through cincturing vertices **6a** along the intersecting planes of longitudinal trusses **12**. Vertices **6a** in this embodiment are bent at an angle and at a location as to allow them to lie flush with each other, to be sandwiched between the double cords of a longitudinal truss, and to protrude beyond said cords sufficiently to allow a connecting transverse cords **8c,d** to be threaded through the cincturing girdle formed between said dual cords and protruding vertex. **11** Said cords **12** form alternating lines from side to side of a so comprised space frame along said space frames longitudinal axis at the alternating vertices **6a** of the continuous web **7** element initially described. Alternating intersecting planes of trusses **12** in both longitudinal and transverse axes of a consequent space frame form substantially square based pyramidal structures. Each cinctured vertex **6a** of a frame is one corner of the square base of one or more said structures, depending upon location at an edge, corner, or in the field of a panel of this configuration of space frame, as well as summit vertex **6a** of an inverted neighboring one, the alternate square bases forming a substantially planar opposite surface lattices of a space frame.

Other Embodiments

Independent aperture – Description

A continuous loop of reinforcement bent, woven, folded, tied, sewn, twisted or

otherwise formed to conform to reinforcement in the array to provid means for the aperture of at l ast two elements of the reinforcement array.

Independent aperture -- Operation

Independently locatable apertures can be shaped in a variety of shapes. When placed onto the array locatable apertures require cross reinforcement to by communicated into and held disposed within said aperture to effect installation of said aperture.

Double webbed Trusses -- Description

Trusses with apertures that contain at least one cord and at lease two web elements generally juxedopposed to one another to form, when viewed in the transverse elevation, opposing vertices across the transverse axis.

Double webbed Trusses -- Operation

All aperture trusses operate in a similar fashion and methodology. Each having distinct differences in an engineered analysis.

Foundation or grade beam reinforcement -- Description

Trusses so equipped with aperture devices are positioned to space, align, and support reinforcement extending through and between foundation cementations and connecting structures. Use of trusses with apertures aligns such reinforcement to coincide with reinforcement of the supported reinforcement array. Similarly such use is appropriate and desirable for bond beam construction.

Foundation or grade beam reinforcement -- Operation

Trusses are rotated 90 degrees to one another so as th transv rse face of foundation reinforcement trusses and bond beam trusses transverse face faces

one another sandwiching a plurality of trusses so equipped and cincturing at least one of each trusses longitudinal cords (in the case of a bond beam) and or foundation/connecting reinforcem nt in th case of use in foundation.

One Cord Truss – Description

An asymmetrical truss with vertices bent in such a manner that said vertices grab or gird reinforcement such as the cord of an other truss when cross reinforcement is disposed within said trusses apertures to provide means for additional lateral or longitudinal reinforcement and load resisting capacity.

One Cord Truss – Operation

This device is used at openings in arrays by attaching the un-corded and bent vertices to longitudinal or lateral cords in an array and cincturing said one cord truss to said array with cross reinforcement.

Conclusions, Ramifications, and Scope

Accordingly, it can be seen that Accordingly, the Anvick composite ***aperture*** connection of this invention can be used in structural cementations and other hybrid material structures

The walls can be pre assembled, or pre-formed, offsite according to the required size dimensions and then transported to the job site.

Rapid instillation

Can be made from 100% recycled materials

Reduces demand on energy

Structurally more efficient

Materials and labor force readily available word wide

Meets extreme climactic nvironmental and climatic challenges

More durable structures

Although the description above contains many specificities, these should not be construed as limiting th scope of the inv ntion but as merely providing illustrations of some of the presently preferred embodiments of this invention. Various other embodiments and ramifications are possible within it's scope. For example,
a continuous element can be formed into an entire panel array forming transverse, lateral, and longitudinal elements from one continuous element. Simple trusses of conventional re bar can be permitted by building officials without need for testing. Elements of differing configurations can be intermixed throughout an array. And many other potential configurations can be made.

Thus the scope of the invention should be determined by the appended claims and their legal equivalents, rather than by the examples given.